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Surgical site infections prevalence among caesarean section patients

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ABSTRACT

Introduction: Cesarean section is one of the most prevalent surgical procedures in the world and Surgical Site Infections (SSI) are the most common complication following Cesarean section. This leads to greater patient dissatisfaction, longer hospital stays, and higher treatment costs. The aim of this retrospective study is to determine the prevalence of wound infection and the prevalence of bacterial isolates in post-Cesarean section and its sensitivity to variant antibiotics.

Material and methods: Samples were collected from patients who had developed wound infection following cesarean section and cultured on blood, chocolate and chromatic agar. The isolated bacteria was identified by ordinary microbiology techniques.

Results: Among 4,482 Cesarean section patients in Albaraa Hospital, the surgical site infections (SSI) rate was 2.94 %. Microorganisms isolated from these cases included *Candida albicans* at a rate of 0.11%. The remaining 2.83% were bacterial isolates, with 70.1% being gram-positive bacteria significantly higher than the 29.9% attributed to gram-negative bacteria (P = 0.01). The main bacteria isolates were *Staphylococcus aureus* (37.8%), *Staphylococcus epidermidis* (23.6%), *Pseudomonas aeruginosa* (11.4%), *Klebsiella pneumonia* (8.3%), *Escherichia coli* (5.3%) and *Alpha hemolytic Streptococcus* (3.8%)

Conclusions: The SSI rate in this study was at the lower limit of the WHO predicted infection rate and the bacterial isolates were sensitive to many antibiotics. This result may be due to the pre, intra and postoperative prophylactic antibiotics administered to patients and other factors such as short hospital stay and staff training in aseptic techniques. This study recommends further assessment of SSI in alternative surgical procedures, and assess the efficiency of prophylactic antibiotics in alternative surgeries in Libya.

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Prevalencia de infecciones del sitio quirúrgico entre pacientes de cesárea

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RESUMEN

Introducción: La cesárea es uno de los procedimientos quirúrgicos más frecuentes en el mundo y las infecciones del sitio quirúrgico (ISQ) son la complicación más común después de una cesárea. Esto conduce a una mayor insatisfacción de las pacientes, estancias hospitalarias más prolongadas y mayores costos de tratamiento. El objetivo de este estudio retrospectivo es determinar la prevalencia de la infección de la herida y la prevalencia de aislamientos bacterianos en el post-cesárea y su sensibilidad a los antibióticos variantes.

Material y métodos: Se recogieron muestras de pacientes que habían desarrollado una infección de la herida después de una cesárea y se cultivaron en agar sangre, chocolate y cromático. Las bacterias aisladas se identificaron mediante técnicas de microbiología ordinarias.

Resultados: Entre 4.482 pacientes de cesárea en el Hospital Albaraa, la tasa de infecciones del sitio quirúrgico (ISQ) fue del 2,94%. Los microorganismos aislados de estos casos incluyeron Candida albicans a una tasa del 0,11%. El 2,83% restante fueron aislamientos bacterianos, de los cuales el 70,1 % fueron bacterias grampositivas, significativamente más altas que el 29,9% atribuido a bacterias gramnegativas (P = 0,01). Los principales aislamientos bacterianos fueron *Staphylococcus aureus* (37,8%), *Staphylococcus epidermidis* (23,6%), *Pseudomonas aeruginosa* (11,4%), *Klebsiella pneumoniae* (8,3%), *Escherichia coli* (5,3%) y *Streptococcus alfa hemolítico* (3,8%)

Conclusiones: La tasa de SSI en este estudio estuvo en el límite inferior de la tasa de infección predicha por la OMS y los aislamientos bacterianos fueron sensibles a muchos antibióticos. Este resultado puede deberse a los antibióticos profilácticos pre, intra y posoperatorios administrados a los pacientes y a otros factores como la corta estancia hospitalaria y la formación del personal en técnicas asépticas. Este estudio recomienda una evaluación adicional de la SSI en procedimientos quirúrgicos alternativos y evaluar la eficacia de los antibióticos profilácticos en cirugías alternativas en Libia.

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1. INTRODUCTION

Cesarean section is one of the most common surgical procedures performed worldwide and surgical site infection (SSI) is one of the most common complications [1]. SSI is defined by the Center for Disease Control and Prevention (CDC) criteria as an infection that occurs within 30 days after a surgical procedure. The incident rate is estimated between 3-15%, leading to increased costs, higher rates of patient dissatisfaction, increase length of hospital stay and high mortality and morbidity rates [2]. Microorganisms can infect surgical wounds through contaminated caregivers or surgical instruments, airborne pathogens, or microorganisms already present on the patient's body [3]. The most common pathogens causing SSI after Cesarean section are *Staphylococcus aureus*, *Escherichia coli*, *Proteus mirabilis*, *Ureaplasma urealyticum*, *Staphylococcus epidermidis*, *Enterococcus facialis*, and groups A or *Beta-Hemolytic Streptococcus* [4-6]. Epidemiological and clinical studies suggest that there is an increase in C-section rates with an expected increase in SSI rates. Therefore, developing strategies to diagnose, treat and prevent infection will be essential to reduce post-cesarean morbidity and mortality [2, 7-9].

The SSI following Cesarean section delivery is 5-20 times increased compared to vaginal delivery due to various reasons. Firstly host-related factors such as maternal age, obesity, residence, gestational diabetes mellitus, previous Cesarean delivery, recurrent pregnancy loss, and maternal preoperative condition. Secondly intrapartum-related factors such as hypertensive disorder, gestational diabetes mellitus, twin pregnancy, preterm rupture of membrane and finally the procedure-related factors which is depending on a greater number of vaginal examinations, prolonged trial of labor prior to surgery, epidural use, use of internal fetal monitoring, and lack or improper use of antibiotic pro-phylaxis [10, 11]. It is important to understand the prevention guidelines of surgical site infection, which includes preoperative prevention such as preoperative

showering, nasal decolonization, and no hair removal 7 days prior to surgery, staff theatre wear and preoperative antibiotic prophylaxis [12]. Intra-operative prevention such as hand decontamination, sterile gowns, antiseptic skin preparation, wound closure method and wound dressing, prophylactic antibiotics are advised to be given before skin incision. In addition, postoperative prevention as changing dressings, postoperative wound cleansing and care and Cesarean section SSI surveillance, when surgical site infection is suspected give antibiotic that covers the most likely causative organisms, consider local resistance patterns [12, 13]. Antibiotic resistance is rising globally, which poses a significant threat and diminishes the efficacy of common antibiotics against widespread bacterial infections. This makes it difficult or impossible to treat, leading to an increase in the risk of disease spread, severe illness, disability and death. The emergence and spread of drug-resistant pathogens threaten our ability to perform life-saving procedures, including Cesarean section and other surgeries [14]. The aim of this retrospective study is to determine the prevalence of SSI and the prevalence of bacteria isolated in post- Cesarean section and its resistance to variant antibiotics.

2. MATERIAL AND METHODS

This study was conducted at Albaraa Hospital from 2018 to 2023, all wound swab included in this study were collected from all patients who had developed wound infection following Cesarean section within one month after discharge from hospital. 194 wound swab samples were collected aseptically to avoid contamination of the specimens with normal microbial flora of the skin. The collected swabs were inoculated by using the streaking technique to expose bacteria in a good growing medium of blood agar, chocolate agar and chromatic agar medium and incubated aerobically and anaerobically at 37 C° for 24 hours. The isolated bacteria were identified by ordinary microbiological techniques.

The Kirby–Bauer disc diffusion method was used in the Antibiotic Sensitivity test of the identified bacterial isolates [15]. Antibiotics are used depending on the antibiotic policy of the hospital (Recommended Antimicrobial Disks and Interpretative Zone Sizes in Kirby-Bauer Disk Diffusion Susceptibility Test Protocol) [15]. After 18–24 hours of incubation, the diameter of the inhibitory zone was measured using a millimeter scale. The zone size around each antimicrobial disc was interpreted as sensitive, intermediate or resistant, according to the Clinical and Laboratory Standards Institute (CLSI) criteria.

The paired T-test from SPSS software was used for data analysis and comparing between groups and P value < 0.05 is considered significant.

3. RESULTS

The number of Cesarean section referred to Albaraa Hospital from 2018 to 2023 were 4,482 C-section patients. Among them, 194 (4.33 %) wound swabs were sent to the lab for culture and sensitivity. The results showed 62 (31.9%) swabs had no growth of microorganisms and 132 (68.1%) swabs had pathogenic microorganisms. There were 5 *Candida albicans* (0.11%) and 127 bacterial isolates (2.83%), among the total bacterial isolates; there were significantly higher gram-positive bacteria (70.1 %) than gram-negative bacteria (29.9%) (P = 0.01) (Table 1).

Table 1: The correlation between the number of years from 2018 to 2023 and isolated gram negative and gram positive bacteria

	2018	2019	2020	2021	2022	2023	Total
Number of caesarean section	790	979	925	666	541	581	4482
Number of wound swabs	28	38	33	35	32	28	194 (4.33%)
Total bacterial isolates	22	26	25	26	16	12	127 (2.83%)
Gram positive bacteria	17	15	19	20	11	7	89 (70.1%)
Gram negative bacteria	5	11	6	6	5	5	38 (29.9%)

The main bacteria isolated from the SSI was *Staphylococcus aureus* (37.8%) followed by *Staphylococcus epidermidis* (23.6%), *Pseudomonas aeruginosa* (11.4%), *Klebsiella pneumonia* (8.3%), *Escherichia coli* (5.3%), *Alpha haemolytic Streptococcus* (3.8%), *Candida albicans* (3.78%), *Corynebacterium* (2.27%), *Proteus mirabilis* (1.5%), *Bacilluscereus* (1.5%), and *Acinobacter* (0.75). Table 2 summarizes the sensitivity results of the antibiotics tested with isolated bacteria , there were 30% of bacteria sensitive to Ceftriaxone, 11.8% were sensitive to Amoxicillin/clavulanic acid, while 38% of isolates were resistant to Ceftriaxone and 76.5% were resistant to Amoxicillin/clavulanic acid.

Table 2: The results of antibiotic sensitivity test in all bacteria isolated			
Antibiotic	**Sensitive (%)**	**Intermediate (%)**	**Resistance (%)**
Amoxicillin/clavulanic acid	11.8	11.7	76.5
Penicillin	5.3	5.3	89.4
Fluclixacillin	25	42.4	15.7
Piperacillin	42.1	42.4	38
Ceftriaxon	30	32	38
Ceftazidime	33.3	39.4	27.4
Cetotaxime	28.9	20	51.1
Cefoxitin	26.7	26.7	46.6
Cefoperazone	50	0	50
Ciprofloxacin	80	6.7	13.3
Novoflaxacin	50	0	50
Azithromycin	67.6	10.8	21.6
Erythromycin	70.9	12.7	16.4
Sulfamethoxazole + trimethoprim	50	12.5	37.5
Vancomycin	79.2	1.3	19.5
Gentamicin	63.5	7.7	28.8
Amikacin	75	13.5	11.5
Tobromycin	86.7	0	21.5
Clarithromycin	71.4	7.1	21.5
Ampicillin	8.7	32.6	58.7
Imipenem	95.6	0	4.4
Meropenem	97.1	0	3.1
Tetracyclines	61.1	11.1	27.8

4. DISCUSSION

Wound infections are still regarded as the most common nosocomial infections in patients undergoing surgery. The hospital environment and equipment's may act as a reservoir of pathogens contributing to cross transmission at patient's surgical sites [15]. Therefore the lack of cleaning hospital surfaces with germicide disinfectant may increase the prevalence of serious infections including surgical site infection that caused mostly by *Staphylococcus aureus* and other pathogens including *Klebsiella pneumonia*, *Pseudomonas aeruginosa* and *Escherichia. coli* [4, 16, 17, 18, 19]. This study in agreement with the previous finding, and the *Staphylococcus aureus* (37.8%) was the most common pathogen isolated from C-section delivery followed by *Staphylococcus epidermidis* (23.6%), *Pseudomonas aeruginosa* (11.4%) and the lowest isolated was *Acinobacter* (0.75%).

There is a wide range of studies that have been published globally reporting that the SSI after Cesarean section varies from 3.0% in Turkey, 5.5% in the USA, 9.5% in Saudi Arabia, 14.4% in Jordan, 18.8% in Malaysia and up to 23.5% in Brazil [6, 20-24]. The SSI rate of our study was 2.94%, which is at the lower limit of infection rate compared with the global prevalence rate and less than the average rate observed by the World Health Organization (3–15%) [2]. There are many factors involved in reducing SSI rate including, patients clinical situation, hospital stay after Cesarean section and the understanding of infection prevention among hospital health workers [25].

The raise of antimicrobial resistance globally threatens the effective prevention and treatment of infections following Cesarean section, which increases the risk of disease spread, severe illness and death [14], while the surgical antimicrobial prophylaxis (SAP) for Cesarean section provides a 30–65% reduction of wound infections among women who undergo either elective or emergent C-section delivery [26]. The Cephalosporines and Penicillins are the most common antibiotic that have been used in Cesarean section [27]. In this study the Ceftriaxone and Metronidazole were used routinely as SAP pre, intra and post-operative up to 2 days for all patients undergoing Cesarean section surgery, remarkably the bacterial isolates were sensitive to most antibiotics tested, among them 30% of bacterial isolates were sensitive to Ceftriaxone. This might explain the low SSI rate following Cesarean section, although other study in people's hospital of Linyi in China prescribed Ceftriaxone and Sulbactam antibiotic after Cesarean section showed the SSI rate was 27% [28]. The resistance rate to SAP might increase the SSI rates. As seen in a study in western Nepal the SSI rate was 64.5% with 87.3% of bacterial isolates resistant to Ceftriaxone. A further study in northeast Ethiopia showed SSI rate at 14.5% with Ceftriaxone resistance rate at 73.9 %. In our study, the SSI rate was 2.94 % with Ceftriaxone resistance rate 38%. This may contribute to the low rate of SSI after Cesarean section

surgery, which is disagree with Rwanda, study were the SSI rate after Caesarean section was 5.7% with 92% Ceftriaxone resistant rate among bacterial isolates [18, 29, 30].

The resistance rate against antibiotics among the bacterial isolates in this study were mostly resistant to Penicillin, Amoxicillin/Clavulanic acid and Ampicillin (89.4%, 76.5% and 58.7% respectively). In addition, it was mostly sensitive to Meropenem and Imipenem (97.1% and 95.6% respectively) which is in agreement with the study in northeast Ethiopia that showed *Staphylococcus* species 100% resistant to penicillin and 98.2% of gram negative bacteria resistant to Ampicillin [29]. Similar results were observed in Nigeria, were 85% of *Staphylococcus aureus* were resistant to ampicillin and 90% resistant to penicillin [31], while another study showed 100% of *Staphylococcus aureus* isolated were resistant to Amoxicillin/Clavulanic acid and meropenem [6].

In conclusion, many clinical trials have been explored to reduce the SSI rate following Cesarean section. In this study, the SSI rate was at the lowest limit of infection rate when compared with other studies worldwide, as well as the bacterial isolates were sensitive to many antibiotics tested. This is largely due to the pre, intra and postoperative antibiotics prophylaxis used, short hospital stay after Caesarean section and staff education in sterilization, scrub techniques and wound dressing techniques. This study recommends the use of Ceftriaxone and Metronidazole as SAP for Caesarean section surgery and further studies required to assess the SSI rate and determine the efficiency of prophylactic antibiotics used in alternative surgical procedures Libya.

5. CONFLICT OF INTERESTS

The authors have no conflict of interest to declare. The authors declared that this study has received no financial support.

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